Coastal Flood Hazard Analysis for Vashon and Maury Islands

FEMA Region X
King County River and Floodplain Management Section

Public Meeting
April 28, 2011
Agenda

• Introductions
• Background on King County Flood Studies
• Technical Overview of Coastal Flood Hazard Study of Vashon and Maury Islands
• Overview of FEMA National Flood Insurance Program
• King County Proposed Coastal Flood Hazard Regulations
• Questions
Coastal High Hazard Area
Flood Mapping

• Why do we need new flood hazard maps?
  – Current maps are approximate: flood zone A (largest A Zone in the County)
  – A Zones are not the result of technical analysis
  – Current maps are from the 70s and have known errors: high bluffs mapped in the flood zone.
  – New maps created from current data and analytic methods.
Key Technical Tasks

• Field Surveys and Reconnaissance
• New Aerial Photography
• Topographic Data Development
• Offshore Wave Modeling
• Nearshore Hydraulic Modeling
• Statistical Analysis/Floodplain Mapping
• Sea-level Rise Evaluation
Field Surveys and Reconnaissance

• Field Reconnaissance by King County and NHC staff on August 17, 2009

• Supported by Pacific Geomatic Services survey boat

• Collected video and photographic information
Aerial Photography

- Aerial photography of Vashon-Maury Island on March 11, 2009
- Individual Digital Photo Tiles and MrSID mosaic
- Data used for detailed topographic mapping and feature data collection of shoreline areas
Topographic Data Development

- Developed by 3DI-West using aerial imagery
- 2-foot contour mapping from 0-foot to 50-foot elevation or higher
- Topographic maps produced at a scale of 1 inch = 500 feet
Topographic Data Development

- Used NOAA bathymetric soundings – surveys conducted from early 1800s to present
- Merged with topographic data to create seamless bathymetric surface
Numerical Analyses

Offshore to Nearshore Currents, Winds & Waves

Nearshore to Land Runup & Overtopping

Landward of Crest Bore Propagation
Offshore to Nearshore – Wave Modeling

- Bathymetry
- Tides
- Wind
- Waves
Offshore to Nearshore – Wave Modeling

Model Used
• Simulating WAves Nearshore (SWAN) [FEMA approved model]
• 2-D Wave Propagation and Wave Transformations

Model Input
• NOAA Bathymetry data (underwater topography)
• Wind data

Model Output
• Tidal Data
• Still Water Elevations
• Wave Heights, Velocities, Periods, and Directions
SWAN Model Domain and Grid

500m

100m
SWAN Model Input - Wind Data

Primary Historic Record
• 60 years of NWS observations at SeaTac

Spatial Distribution
• Correlation with 15 regional wind gages
SWAN Model Input - Tide Data

**Predicted Tides**
- Based on astronomical constants
- Repeating pattern every 18.6 years

**Residuals (difference between observed and predicted)**
- Based on 70 years of data at Seattle NOAA gage
- Residual = Observed – Predicted Tide
- Statistical analysis of residuals
SWAN Model Output

- Still Water Elevations
- Wave Height
- Wave Period
- Wave Length
- Wave Direction

![Diagram of wave characteristics](image)
Nearshore to Land – Runup and Overtopping

Coastal Geometry

Wave Runup

Total Water Level

Using Methods and Equations from FEMA Pacific Coast Guidelines

Wave Data

From SWAN

Cross-Shore Transects

From Topography/Bathymetry
Nearshore to Land – Runup and Overtopping

Model Used
• FEMA Pacific Coast Guidelines
• Runup and Overtopping Equations for Beaches and Structures

Model Input
• Wave and Tide Data from SWAN Model
• Transect Geometry (bathymetry/aerial photogrammetry)
• Transect Characteristics (berms, toes, crests, surface roughness, shore angle, etc.)

Model Output
• Total Water Level (TWL) Elevations for Each Event
Cross-Shore Transects
Cross-Shore Transects
Nearshore to Land – Model Results

- Wave runup
- Total water level
- Overtopping (in some cases)
Landward of Crest (if overtopping occurs)

- Bore Propagation or Splash
- Elevation of AE Zone

\[ R' / z_c' > 2 \]
Propagating Bore Occurs
Statistical Analysis

For Each Transect:

• Hypothetical 1000 year record of tides/winds/wave events created

• Detailed simulations performed for 10 highest tides and 10 highest wind events in each year

• 100-year and 500-year event data for total water level, overtopping flows, and inland extent of flooding extracted from 1000-year record
Floodplain Mapping

For Entire Vashon-Maury Island Coastline:

• 100-year Total Water Levels mapped
• VE and AE Zones delineated according to FEMA Pacific Coast Guidelines
• Work maps produced at a scale of 1 inch = 500 feet
• FEMA DFIRM database created
• Flood Hazard Atlas produced at scale 1 inch = 200 feet
• Mean High Water – Important Regulatory Elevation
Sample from Work Map
Example DFIRM*

* This graphic shows what the final FEMA DFIRM products will look like once the VMI study is reviewed and published. This map is from the FEMA DFIRM for Burien WA.
Sea Level Rise Scenario

- Based on assumption of 2 foot increase in sea level (tidal water surfaces).
- Wave runup and overtopping recomputed with revised tide data.
- Changes in coastal flood hazard (total water levels) mapped for assumed sea level rise.
- Estimated increase in TWL ranged from 0.5 to 6 feet.
Sea Level Rise Scenario

Large map displayed on wall – for informational purposes only

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Change (feet)</th>
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<tbody>
<tr>
<td>Min</td>
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</tr>
<tr>
<td>Max</td>
<td>6.04</td>
</tr>
<tr>
<td>Median</td>
<td>2.53</td>
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</tbody>
</table>

Estimated Increase In Total Water Level (TWL)
Resulting from a hypothetical increase in sea level of 24 inches

- 0.5 - 1.5 feet
- 1.5 - 2.5 feet
- 2.5 - 3.5 feet
- 3.5 - 4.5 feet
- 4.5 - 5.5 feet

Note: Baseline flood hazard data (VE and AE zones) shown on map corresponds to Vashon-Maury Island Coastal Floodplain Mapping Study, King County, April 2011
Switch to FEMA Presentation
Coastal High Hazard Area
Flood Regulations

• Why do we need new flood regulations?
  – Current maps designate coastal area as flood zone “A”
  – King County has flood regulations for “A” zones
  – New maps will establish AE and VE
  – King County has flood regulations for the AE zone but not the VE zone

• National Flood Insurance Program requirement
Summary of New Coastal High Hazard Area Flood Regulations

- Elevate new buildings and substantial improvements on pilings and columns.
- Non-supporting open lattice-work allowed under finished floor.
- The lowest floor must be three feet above the 100-year flood elevation (current code).
- The foundation must be anchored to prevent flotation, collapse and lateral movement.
Summary of New Coastal High Hazard Area Flood Regulations Cont.

• A registered professional engineer or architect must prepare the structural design.
• All new buildings must be landward of mean high tide.
• The space below the lowest floor must be free of obstruction and used only for parking, access or storage. No human habitation is allowed below the lowest floor.
• Fill is not allowed for structural support.
Summary of New Coastal High Hazard Area Flood Regulations Cont.

• FEMA elevation certificate required.
• Manufactured homes must meet the same standards as new buildings or substantial improvements to existing buildings.
• Recreational vehicles must be on site for fewer than 180 days or be ready for highway use.
SEPA Threshold Determination

• King County has issued a State Environmental Policy Act (SEPA) Threshold Determination of Non-Significance for proposed regulations
• Comment period April 21 to May 13
• No administrative appeal
How Can I Comment on Regulations and SEPA Threshold Determination?

King County River and Floodplain Management
Priscilla Kaufmann, CFM, Project Manager
(206) 296-8380
Priscilla.kaufmann@kingcounty.gov

Comments must be received by May 13, 2011
Upcoming Milestones

Coastal Flood Hazard Maps and Study:

May – Receive public comments

July – Revise Study as Necessary and Provide Draft Maps and Technical Data to FEMA for Review

July – September (?) – FEMA Review

2012 – FEMA Preliminary Flood Insurance Rate Map and Study
Mapping Study Contacts

King County River and Floodplain Management
Jeanne Stypula, Supervising Engineer, (206) 296-8380
Jeanne.stypula@kingcounty.gov
Kyle Comanor, Project Engineer, (206) 684-1272
Kyle.comanor@kingcounty.gov

FEMA Region X, Mitigation Division
John Graves, Senior NFIP Specialist, (425) 487-4737
john.graves1@dhs.gov

Washington Department of Ecology
David Radabaugh, State NFIP Coordinator, (425) 649-4260
drad461@ecy.wa.gov